The RIA project and heavy element physics

J.A. Nolen[1]

[1] Physics Division, Argonne National Laboratory

nolen@anl.gov

An overview of the U.S. Rare Isotope Accelerator (RIA) Project is given in a companion paper by D.J. Morrissey at this conference. In this paper some specific capabilities of the proposed facility for research on the production and studies of heavy elements will be discussed. First, baseline count rate predictions for sample radioactive beams will be given, and then examples of possible enhancements of these capabilities will be presented.

In recent years there has been much discussion and speculation about the role of radioactive beams in research related to super-heavy elements. This paper will explore the capability of RIA to deliver precise and intense radioactive beams of neutron-rich fission products at Coulomb barrier energies for fusion reactions. The best mechanism for the production of such beams is the 2-step, neutron-generator configuration of the standard ISOL technique. The RIA driver will provide beams of protons, deuterons, or other light ions in the energy regime of 1 GeV with beam powers up to 400 kW. Providing the most intense reaccelerated beams for heavy element research using this method will require optimization of each step in the process. With reasonable assumptions about target, ion source, and post acceleration developments fission fragments near the peaks of the distributions, such as ^{132}Sn and ^{140}Xe, should be available with on-target intensities of 10^{10} to 10^{11} ions per second. The details of the various necessary efficiencies and developments necessary to reach these intensities will be discussed. Possible extensions of the method to intensities above 10^{11}/s will also be considered.

Using radioactive ^{132}Sn on stable targets, compared with stable beams on ^{208}Pb targets, the corresponding compound nuclei have 8 more neutrons at element 118 and 12 more at element 120, for example. Hence, the possibilities of increased production cross sections and longer half-lives of the more neutron-rich isotopes may overcome the 10-100 times weaker beam intensities. New instruments, such as the MASHA spectrograph currently being commissioned in Dubna, may be well suited to studies with radioactive beams such as the ones mentioned above. The post-accelerator RIA will also be able to provide intense CW beams of stable ions for measurements complementary to those with radioactive beams.

Research supported by the U. S. Department of Energy under contract W-31-109-ENG-38.